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ABSTRACT

Bloom's Taxonomy is reviewed and analyzed in this report; the summative finding being that few educational innovations have had equal impact upon the profession. The taxonomy is first defined with particular attention being paid to "Handbook 1: Cognitive Domain." Various universities' and colleges' use of the taxonomy is described. Problems of research are discussed and a review of the research provided. Problems growing from the taxonomy in terms of application are also discussed. It is suggested that, because the taxonomy has influenced such a diverse group of people as researchers, measurement specialists, curriculum developers, and teachers, the problem with the taxonomy must be recognized as one of communication. There is noted to be a wide gap between those who expose the construct and those who put it to use. (JM)

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CHALLENGES TO CURRICULUM AND TEACHING BASED ON BLOOM'S TAXONOMY

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Preface

This paper has its beginnings in a conversation about undergraduate teacher preparation during the late 1970's. From the conversation an opportunity emerged which put me into direct contact with Joseph Gomez of the Dade County Public Schools to seek more information about the validity of Bloom's Taxonomy. After our first cut at the question, we were joined by Barbara Bader in an effort to better understand the implications of Bloom's Taxonomy on our professional practices.

A first paper was presented at the annual meeting of ASCD in 1982 and represented a refinement of our initial work. This paper will, hopefully, present a more critical analysis of our concerns. I am grateful to the initial research efforts of Joseph Gomez as they proved invaluable in shaping this work. I am also appreciative of the perseverance of Barbara Bader to keeping the quest alive over the last several years.

SMF

INTRODUCTION

The Association of College and University Examiners gathered in Boston in 1948 as part of the American Psychological Association Convention. Their conference dealt with the problem of formulating valid examinations that could measure the degree to which a student had met course objectives. Teacher educators had been involved in this quest for more than a century when the Association addressed this issue.

In 1839, Horace Mann created the first state teacher training institution. The Normal School Movement grew quickly. The McMurrys worked to introduce the theories of Johann Herbart into the preparation of teachers. The Oswego Movement advocated the ideas and methods espoused by Pestalozzi. The emerging field of psychology was fast becoming the "master science" of education. By 1900, sixty years of study and effort resulted in the assimilation of ideas and the establishment of Educational Psychology as the science of education. (Cubberly, 1934 and Seguel, 1966).

The fact is that, by the time the college examiners convened at the American Psychological Association Convention, the foundation of the teaching profession had been laid. Normal Schools focused on questions related to educational philosophy, educational psychology and methodology. Even as normal schools began to be replaced by four year teacher education programs at colleges and universitites, these foundations remained.

The power of the quest for valid measures of student learning indicated the power of those committed to a scientific approach to education. Professor Ralph Tyler had begun work on identifying the sources of educational objectives and had integrated the philosophy

and psychology of education into his model presented in 1944 in his significant monograph, Basic Principles of Curriculum and Instruction. Here again the case is made for a "scientific approach" focused upon the assessment of student progress along a continuum of objectives. The evidence is clear to all who pursue the study of education. The key to understanding the success of an educational effort is to be found in measurable objectives.

Of course, there are those who would take serious issue with this position. (Callahan, 1962, Eisner, 1969). However, for the purposes of this paper, it is more beneficial to accept the premise and examine how one might proceed in developing and measuring educational objectives. To this end, this paper will focus upon the Taxonomy of Educational Objectives Handbook 1: Cognitive Domain by Professor Benjamin Bloom.

It is our intent to speak to "Bloom's Taxonomy" as an example and to make the point that, in efforts to subscribe to tenents which seem to be essential and underlying in the development of curriculum and instruction, we may not always be on as firm gound as we seem to feel we are when we conduct the business of our profession utilizing systematic and/or scientific principles unless our foundations are sound. Finally, we intend to present evidence which suggests that, in our efforts to be responsive to theory, we may be engaging in practices which are not consistent with our espoused values.[1]

The Development of the Taxonomy

Benjamin Bloom, as the university examiner of the University of Chicago, assumed a leading role in the Association of College and

[1]Adaptation from Argyris, Chris and Schon, Donald A., Theory in Practice: Increasing Professional Effectiveness (1980)

University Examiners' conference. Bloom was keenly aware that the problem was too important to allow its consideration to be limited by the duration of the conference. During the succeeding years, several members of the Association continued to meet and work on the aspect of the problem generally regarded as most important - the development of a system for classifying educational objectives.

The product of their efforts was a classification system or taxonomy of educational objectives. The taxonomy was organized into three major domains: cognitive, affective, and psychomotor. It was noted that all the objectives drawn from the survey of teachers and the current literature "could be placed rather easily in one of [these] ...domains". (Krathwohl, 1964). The intent was to state the educational objectives in behavioral terms. It was felt that the achievement of educational objectives would be reflected in the behavior of the student, and that this behavior could be observed, described and eventually classified. Furthermore, "It was hoped that placing the objective within the classification scheme would locate it on a continuum. (Krathwohl, 1964). Thus, the taxonomy would essentially be a sequential and cumulative hierarchy.

The Taxonomy as a Tool

Since its publication, Bloom's Taxonomy has been used increasingly by educational researchers, educational evaluators, curriculum specialists, and educators in general. Handbook 1: Cognitive Domain has been the prime focus of attention since it was the first published, and the domain "most central" to the practice of education. For these reasons, this paper will concentrate on this book.

In Handbook 1, Bloom made several suggestions concerning the possible use of the taxonomy. He suggested that it would be useful

to "educational research workers... in formulating hypotheses." It would also be useful to "teachers and testers [by providing] ...a basis for suggestions...for developing curricula, instructional techniques, and testing techniques." It could, furthermore, be used to determine the relevance of "evaluation instruments, techniques and methods." Finally, the taxonomy could be used to identify "a large number of problems in the field of education and testing." (Bloom, 1956).

As previously noted, educational researchers and practitioners have eagerly utilized the taxonomy. For example, it has been used in curriculum development in several California school districts. It has served as the premise for the development of similar taxonomies or models, including one utilized by the American Association for the Advancement of Elementary Science Curriculum Study. Robert Glaser even reports on its use by industrial psychologists in classifying training tasks. "To an undetermined extent, it has served as a guideline in the selection and organization of curriculum experiences." (Kropp, 1966).

Because of this extensive use of the taxonomy, it seems only appropriate to review the research to determine whether an empirical basis exists to justify its popularity. Certain questions need to be addressed. Is the taxonomy useful as a classification system? Is it inclusive of all cognitive processes? Does it actually form a sequential and cumulative hierarchy?

HANDBOOK 1: COGNITIVE DOMAIN

Before a review of the research can be undertaken, however, a closer look at Handbook 1 is warranted. The cognitive domain was the subject under consideration in Handbook 1. Bloom did not precisely

define this domain, beyond stating that it "includes those objectives which deal with the recall or recognition of knowledge and development of intellectual abilities and skills." (Bloom did provide clearer, albeit functional, definitions for the six major classes of the domain.) The classes in hierarchical order, from the lowest to the highest, are the following:

1.00 Knowledge

2.00 Comprehension

3.00 Application

4.00 Analysis

5.00 Synthesis

6.00 Evaluation

The Cognitive Taxonomy

A simplified version of the cognitive taxonomy includes 29 specific sub-categories presented in this section. The six major classes will be defined and comments will be provided where they are deemed appropriate. The reader should be cautioned that these definitions and comments are meant only as a reference for this paper. They do not supplant a first-hand review of Handbook 1.

1.00 Knowledge - The knowledge level refers to the student's ability to recall or recognize information in basically the same manner that it was presented to him/her. The essential behavior elicited by the student is remembering. Questions beginning with who, what, when & where are common in this category. It has twelve sub-categories.

1.11 Knowledge of Terminology

1.12 Knowledge of Specific Facts - dates, names, places, etc.

1.20 Knowledge of Ways and Means of Dealing with Specifics - organizing, studying, etc.

1.21 Knowledge of Conventions - "ways of treating and presenting ideas"

1.22 Knowledge of Trends and Sequences

1.23 Knowledge of Classifications and Categories

1.24 Knowledge of Criteria - "criteria by which facts, principles, opinions and conduct are tested or judged"

1.25 Knowledge of Methodology - "methods of inquiry, techniques, and procedures"

1.30 Knowledge of the Universals and Abstractions in a Field

1.31 Knowledge of Principles and Generalizations

1.32 Knowledge of Theories and Structures

2.00 Comprehension - The comprehension level refers to the student's ability to use previously acquired information (knowledge) to solve a novel problem. This is the most rudimentary level of understanding. It has three sub-categories; this level is further subdivided into the following categories:

2.10 Translation - to accurately paraphrase a communication

2.20 Interpretation - "the explanation or summarization of a communication"

2.30 Extrapolation - "the extension of trends or tendencies beyond the given data"

3.00 Application - The application level, like the comprehension level, refers to the student's ability to use previously acquired information in solving a novel problem. Unlike the comprehension level, where the test item or its context directs the student's attention to the applicable information, the application level's test item does not provide this clue. Thus, before the student can solve the problem, he must determine the appropriate knowledge and recall it. This is the only category that does not have any

sub-categories.

4.00 Analysis - The analysis level refers to the student's ability to identify logical errors in communication. It can also involve the student's ability to recognize and classify relationships among elements in a communication. This level is further subdivided into three sub-categories:

4.10 Analysis of Elements

4.20 Analysis of Relationships

4.30 Analysis of Organizational Principles

5.00 Synthesis - The synthesis level refers to the student's ability to create an original verbal or nonverbal communication, i.e., a short story, a speech, a poster. It can also involve the student's ability to create a procedure or plan for accomplishing a task. This level is further sub-divided into three sub-categories:

5.10 Production of a Unique Communication

5.20 Production of a Plan, or Proposed Set of Operations

5.30 Derivation of a Set of Abstract Relations - to formulate a classification system or to deduce a proposition.

6.00 Evaluation - The evaluation level refers to the student's ability to judge the value of ideas as products and to logically support his judgment. This level is further sub-divided into two sub-categories:

6.10 Judgments in Terms of Internal Evidence - "logical accuracy, consistency, and other internal criteria"

6.20 Judgment in Terms of External Criteria - established by the field

The attention was first concentrated on the cognitive domain

because, in Bloom's words, "This is the domain which is most central to the work of much current test development. It is the domain in which most of the work in curriculum development has taken place and where the clearest definitions of objectives are to be found and phrased as description of student behavior." (Bloom, 1956). The end product, as previously stated, was published in 1956. The companion book, Taxonomy of Educational Objectives Handbook 2: Affective Domain, with David K. Krathwohl as the senior editor, was published in 1964. Together, these two books helped to revolutionize contemporary educational thought.[2]

Many educators welcomed the 1956 publication of Taxonomy of Educational Objectives Handbook 1: Cognitive Domain. The book was the product of a systematic attempt "to put intellectual concerns into proper perspective." (Sylwester, 1971). The imposing title was eventually reduced to, simply, Bloom's Taxonomy, in recognition of its senior editor, Benjamin Bloom.

The Principles of the Cognitive Taxonomy

According to Bloom, the formulation and organization of the cognitive taxonomy was based on four "guiding principles." The first was the acknowledgement that the taxonomy would be used with existing educational units and programs." As such, the taxonomy would accommodate this fact to the extent that this was possible. The second principle was that "the taxonomy should be logically

[2]Handbook 3, covering the psychomotor domain, was never written by Bloom or his collaborators because, according to Bloom, "we find so little done about [the motor skill area] in secondary schools or colleges, that we do not believe the development of a classification of these objectives would be very useful at present." (Bloom, 1956)

developed and internally consistent." Terms would be defined and used in a clear and consistent manner. Levels would permit subdivisions to the extent deemed necessary by the nature of the objectives being classified. The third principle was that "the taxonomy should be consistent with our present understanding of psychological phenomena." This principle was the basis for Bloom's suggestion that the taxonomy would be a useful tool in research (see The Taxonomy as a Tool). Finally, The taxonomy should be a "purely descriptive scheme, in which every type of educational goal can be represented in a relatively neutral fashion." Bloom envisioned the taxonomy to be like a Dewey decimal system for educational objectives.

THE TAXONOMY IN USE

In spite of some of the known limitations of the taxonomy, it is applied in many educational programs. There is substantial evidence that supports the claims made by Bloom and his associates, as to its uses in planning, development and evaluation.

At Florida International University, the taxonomy is introduced to undergraduate education majors in their first general methods course. Students are required to apply it to their lesson plans in terms of categorizing their behavioral objectives. As the semester progresses, lesson plans are requested employing different instructional strategies. One assignment asks for a plan to utilize a discussion strategy. Eight sequenced questions must be formulated, progressing from the knowledge to the evaluation level. In a micro-teaching setting, students are asked to implement their plan, incorporating a minimum of four of their stated questions. Two questions from

the lower categories and two from the higher are required. Each lesson is video-taped to help in self-evaluation. A checklist with pre-established criteria is used to assist with these evaluations. Since the taxonomy is designed to be a cumulative hierachy, it is important for prospective teachers to understand that the beginning questions need to be at the knowledge and comprehension levels. Students should not be expected to apply, analyze and evaluate unless it is ascertained that they understand the basic facts and concepts of the content material. Bloom does caution us, however, that two students solving the same problem may appear to be doing the same things, but in effect one youngster may be solving it from memory, having had the identical problem before, whereas, the other youngster may have never seen the problem before and would need to apply general principles in order to arrive at an answer. Thus, the relationship between the problem and each student's experiences needs to be considered. This factor would also be of consequence when using the taxonomy to classify test exercises.

Students are also required to plan and teach a micro-lesson using a lecture as their main instructional strategy. The stated objective and evaluation must be at one of the three higher levels. Although pupil participation is minimal, closure is to be done by the students. Generally, students do become comfortable with the taxonomy and are able to fulfill the micro-lab requirements.

In addition to applying the taxonomy to lesson plans for micro-teachers, students use the taxonomy as a quide in constructing original classroom tests. Isabel L. Pfeiffer and O. L. Davis, Jr. (1965) report that their use of the taxonomy to analyze classroom examinations revealed a heavy reliance on the knowledge level. Victor Billeh (1974)

did a similar analysis of science teachers' examination questions in Lebanon and found that this over-reliance on the lower levels in not unique to American educators.

In addition to the taxonomy, students are asked to use a Table of Specifications to prepare their tests, which must include questions at each of the six levels. For some, this is a difficult task. The discovery is often made that well balanced tests require references to the stated objectives and possible examination of the taxonomy's sub-categories.

Leon M. Lessinger (1963) and Thomas H. Metos (1966) utilized the taxonomy as a guide for constructing test questions. They developed test banks that were made available to teachers as potential sources of test questions.

Thomas R. McDaniel discusses the designing of essay questions at the different levels of learning. His contention is that, <u>even at the college level</u>, essay questions, whether for in-class examinations or at-home assignments, too often require only lower levels of thought. He states that "...effective essay assignments will improve not only writing ability, but also the student's understanding of the concepts and principles within each discipline. Good writing is good thinking. The taxonomy has helped me to organize instruction around essays that, in turn, require students to organize their learning around the demands of a well-focused and intellectually demanding essay question. When essay questions get beyond the lower levels of knowledge and comprehension--levels which usually ask the student to describe, trace, summarize and discuss - into the higher levels of the taxonomy, students are challenged to be critical thinkers." (1979)

In this general methods course at Florida International University, students are also asked to use the taxonomy as a guide in preparing a unit plan. The taxonomy's role is to see that all relevant thinking skills are included and that objectives are spread among the six major categories. Pupil activities must relate to the objectives and must also be sequentially representative of the lower and higher levels.

The majority of the students are able to successfully fulfill the tasks that are required. Generally, they become aware that objectives, questions, pupil activities and test questions written on the higher levels require more time and thought that those written at the lower levels. Another conclusion is that a more in-depth knowledge of the subject's content is necessary on the part of both the teacher and pupil if, teaching, learning, and evaluation are to take place at the more critical thinking levels.

At Hofstra University, the taxonomy is also used in the undergraduate teaching program. In this program, however, it is not introduced until students do their internship. Seminars held twice a week reinforce some material previously taught and introduce new content. Among the new content is Bloom's Taxonomy. One of the goals of this program is that of self-evaluation. During a fifteen week semester, students are required to audio-tape three discussion lessons. One is done during the initial two-three week period, prior to the introduction of the taxonomy. The second is done in the middle of the term, shortly after the taxonomy has been introduced; the third, towards the end of the term. Students must extract and record all of the questions that they have asked during each of the three lessons. The questions are categorized according to the

taxonomy and tallied. A summary of each lesson is done, followed by a comparison of the three lessons. Students are also taught an interaction analysis system to further assist them in quantifying their teaching behaviors. The obvious goal is to see if there has been a change in teacher behavior regarding the amount of lower order questions as compared to higher order questions. Many students successfully conceptualize the philosophy of the taxonomy and are able to significantly alter their teaching styles. As others have discovered, prior to learning about the taxonomy, teaching reveals a majority of lower order questioning and, as teachers or student teachers become familiar with the levels, they are able to plan for and ask more higher order questions.

O. L. Davis, Jr. and Drew C. Tinsley (1960) have used the taxonomy to analyze the questioning strategies of elementary school teachers in the area of social studies. A heavy reliance on the knowledge level was found.

Davis and Frances P. Hunkins (1966) have analyzed textbook questions. They have found that 85 percent or higher were written at the knowledge level. In 1974, David Trachtenberg updated Davis and Hunkin's study and found a similar overemphasis of questions on the lower levels. However, Gilbert Billings (1971), found that while more traditional science books concentrated their questions at the lower levels, the more recent elementary science curricula include questions at both the lower and higher levels.

In a study of teachers from various grade levels, Irwin A. Wilson (1973), found that training teachers in the use of an interaction analysis system based on Bloom's Taxonomy changed the level of their questioning. The results of this study support the goals of student

teaching programs at Hofstra University. Wilson found that teachers who received this training showed a significantly greater change in their level of questioning than did a control group. The pupils involved displayed a concomitant change in their level of response.

Daniel Arnold and his colleagues (1974) achieved similar results with a group of teachers, as did Tony Williams (1970) in work with secondary level student teachers and Virginia Rogers (1979) in her work with elementary social studies teachers.

All of these programs and studies indicate the potential of the taxonomy in planning and assessing objectives, questions and test items. Most demonstrate the overemphasis on lower level planning, teaching and evaluation.

In addition to teacher training programs, surveys of test questions and questions in textbooks, researchers have directed their attention to applying the taxonomy in elementary school classrooms. Based on the assumption that the main emphasis in schools has been on teaching children "facts", even though there is agreement by teachers, curriculum specialists and learning theorists that it is important to teach children "thinking", a study was developed to test a curriculum designed to teach fifth and sixth grade students "system dynamics thinking", an orientation that parallels Bloom's fourth and fifth levels. Two of the questions being examined were: Could this curriculum be taught effectively to children at all intelligence levels? And, will the data drawn support the assumption that the taxonomy is a cumulative hierarchy?

The study was carried out to see if students' thinking levels could be raised to level five, synthesis. The preassessment test

indicated that the thinking level of the pupils did not go much beyond level three, application.

The conclusions drawn from this study by Nancy Roberts (1976) indicate that the taxonomy is an appropriate and useful guide in the development of a unit and in pupil activities and test questions to evaluate the achievement of the unit's objectives. It is felt that learning took place at all levels of thinking when teacher efforts and materials were directed to these levels, that the taxonomy does represent a cumulative hierarchy of thinking levels and, when teaching is directed at the fourth and fifth levels of the taxonomy, that children with widely varying intellect can be effectively taught.

Up to this point, the research cited and programs discussed have been associated with traditional educational goals and have taken place in traditional academic settings. The student movement of the sixties brought about nontraditional approaches and institutions. A common facet of many of these programs is the major role that students play in determining their academic objectives and evaluation strategies.

Daniel L. Kegan (1977), the director of Institutional Research and Evaluation at Hampshire College, has described how Bloom's Taxonomy has been used at Hampshire for curriculum planning and evaluation. Hampshire is a nontraditional college. The taxonomy was used primarily as a guide in assessing educational objectives and addressing the question of accountability. At Hampshire, very broad goals are established by the college. Specific educational objectives and behavioral outcomes are <u>not</u> pre-planned, as <u>student</u> input and choice are major components of their underlying philosophy.

Partially due to a lack of stated behavioral objectives, programs tend to focus more on process than on product. Process and effect are favored over content and cognitive objectives. The goals that are formulated are not measured directly.

Hampshire recognizes that nontraditional education should not be synonymous with a lack of evaluation or accountability. Bloom's Taxonomy provided a helpful conceptual framework. An examination profile was developed which asked participants to rate, on a five point scale, the extent to which students displayed various skills. Rated skills included the six major cognitive categories of recall, comprehension, application, analysis and evaluation. It is interesting to note that, in this profile, the knowledge level was given more detailed assessment, based on the premise that this level is dominant in traditional education. One of the goals of this study was to assist the faculty in making their academic expectations more explicit, and to help them write more definitive objectives regarding examinations. Kegan states that, if a person is familiar with Bloom's Taxonomy, he/she would be able to rephrase Hampshire's divisional academic policies into taxonomic categories. At the time of publication of the reported study (1977), this had not been officially done. In conclusion, Kegan writes that, "...the cognitive taxonomy of educational objectives can be a useful tool. As with many data tools, its beneficial impact can be synergestically increased if it is appropriately fed back to the participants involved in the program."

It would seem, from this brief review, that the taxonomy has had significant impact upon the practice of education. However,

the fact that a concept is utilized may not be enough to warrant its acceptance as valid in all cases. For instance, man believed that the world was flat for some time. During this period, sailors genuinely feared falling off of the edge of the world. Since it was believed to be true, we must conclude that the sailors who were careful as they sailed further and further out were wise to be weary of the danger they faced.

Similarly, practitioners who apply the taxonomy as a guide for development, teaching, and testing, must be wise. Use of the taxonomy definitely indicates that a practitioner is aware and that the enterprise (whatever it may be) should lend itself to evaluation. Thus, for many, acceptance of the taxonomy is timely and the validity of the construct gains acceptance as a tool. The tool becomes valued, not so much for what it actually does, but because of its acceptance within the realm of practice.

PROBLEMS OF RESEARCH

Had Bloom simply created a classification system comparable to the Dewey Decimal System, it is unlikely that Handbook I would have had a revolutionary effect on educational thought and practice. For as Bloom himself states, a good classification system is "neutral". The cognitive taxonomy, however, was not neutral. Beyond the classification system that was formulated, Bloom wrote of "an unmistakable trend pointing toward a hierarchy of classes of behavior which is in accordance with our present tentative classification of these behaviors." Thus, Bloom proposed not just a classification system that could be simply validated by applying the criteria of "communicability, usefulness and

suggestiveness." He was proposing a hierarchy that could only be validated "by demonstrating its consistency with the theoretical views in research findings of the field it attempts to order." This was a formidable task with a myriad of research problems to consider.

There are several basic assumptions that Bloom makes regarding the nature of the cognitive taxonomy and its application. These assumptions include the following:

1. The processes described are indeed cognitive.
2. The taxonomy is inclusive of all cognitive processes.
3. The arrangement of six classes forms a sequential hierarchy based on the complexity of the cognitive processes.
4. The hierarchy is also cumulative, i.e., the cognitive process of a specific class consists of an accumulation of all cognitive processes at and below that level.
5. The mental processes described in the taxonomy are learned behaviors.
6. The classification system is useful and applicable.

These assumptions serve as a base for generating hypotheses, which "if sustained would tend to validate with empirical data the structure of the taxonomy" (Kropp, 1966). Validation of only the internal structure of the taxonomy, however, would reveal little about its construct of concurrent validity; then, the true educational potential of the taxonomy would not be fully realized. Thus, the problem is one of validating the taxonomy both internally and externally.

General Research Problems

Before the specific problems of internal and external validation are considered, several general research problems must be considered. These problems arise both from the nature of the taxonomy and its intended use, and they can affect either form of validation. They include the following:

1. A response measure that will serve as an indicator of cognitive behavior must be selected.
2. A valid test instrument must be selected or constructed.
3. The individuals who will make the observations must be selected and trained.
4. The subject's content knowledge must be equalized.
5. The appropriate statistical procedure to process the data must be determined.

The selection of the proper response measure is crucial in order to validate a behavioral measure. In the case of this taxonomy, there are two alternatives. The first is determining whether the subject employed the proper cognitive process; this is termed "process response". The problem with process response is readily obvious. The researcher must depend on the subject to provide the information pertaining to the cognitive process utilized. Not only is this time-consuming, but subjects often "seem to be unable to verbalize their solutions". (Kropp, 1966). The second response measure depends on whether the subject provides the correct answer to an item; this is termed "product response". In this situation, the researcher assumes that the subject utilized the appropriate cognitive process, since the item was correctly answered. The

problem with product response thus becomes one of item validity.

This leads to the second general problem of research, the construction of a valid test instrument. Since Bloom's Taxonomy introduced a unique classification system for cognitive behavior, the validated instruments needed to conduct research are not readily available. This condition places the burden of creating and validating the instrument on the researcher. In turn this may leave conclusions vulnerable to criticism based on the instrument's questionable validity.

Closely associated with the problem of instrument validity is a problem that could be termed "judge validity". This is the selection and training of the individuals who will make observations. These observations include not just the observation of the subjects but the classification of behavior according to the taxonomy. Inter-judge agreement thus becomes crucial, for it reflects not just on the immediate study but on the value and utility of the classification system itself.

The equalization of the subject's content knowledge is the fourth general problem. "Because a solution to an item is contingent on both content and process..., it is mandatory to equalize content knowledge over subjects." (Kropp, 1966). If this is not done, it will be impossible to determine if a correct response to an application class item was the result of the appropriate use of the application cognitive process or the student's prior knowledge of the solution - the latter behavior being only a Knowledge Class cognitive process. Two alternatives are available to equalize content knowledge. The first is simply to assume that the subjects have equal content knowledge by virtue of either common antecedent

experience or the unique nature of the subject matter. The second alternative is to introduce the subject matter at the time the response measures are collected. The typical mode is to preface the test or observations with a reading passage which is hopefully equally unfamiliar to all subjects. This second alternative is "more defensible, despite some apparent weaknesses which inhere in it." (Kropp, 1966).

Finally, the selection of the proper statistical procedure is a general problem in both the internal and external validation. In terms of the international validation it is a particularly acute problem, because of the unique nature of test scores generated by a hierarchy and the dearth of statistical procedures that are applicable to a hierarchy.

REVIEW OF THE RESEARCH

Bloom made numerous claims concerning the value and use of the cognitive taxonomy (see Taxonomy as a Tool). The claims, however, can be consolidated into two general functions. First, the taxonomy is a classification system for educational objectives. Secondly, the taxonomy represents a hierarchy of cognitive processes. These two functions are quite distinct in nature. The classification system has practical implications, particularly in the area of applied research in the educational psychology. The research to date generally reflects this division of functions, for this reason it would be convenient to consider the classification system and the hierarchy separately.

Research on the Cognitive Hierarchy

In order to validate the cognitive hierarchy, it is necessary that researchers demonstrate "its consistency with the theoretical views in research findings" of educational psychology (Bloom, 1956). To achieve this objective, studies have utilized various techniques to collect and process data; however, the focus has generally been on the structure of the hierarchy itself. Researchers seemed to be more interested in the implication of the cognitive hierarchy than the relationship of the cognitive processes to the hierarchy. In other words, researchers appear to be more concerned with what the cognitive hierarchy says about educational psychology than vice versa. Could it be that researchers, as well as curriculum specialists and educators in general, have been awed by the hierarchy?

In order to deal with this question, one must examine the research to date. Numerous studies have been generated by the cognitive hierarchy; the following are generally regarded as the most significant:

Stoker and Kropp (1964)

Smith (1968)

Poole (1971)

Madaus, Woods and Nuttal (1973)

The most notable of all the studies to date was chronologically the first, Stoker and Kropp (1964). This study not only established many of the data processing techniques that would later be replicated but, along with follow-up studies conducted in 1966, produced the test instruments that other investigations would eventually utilize. The study considers the cognitive taxonomy both from the perspective of a classification system (see Research on the

Classification System) and from the perspective of a hierarchy.

Two tests based on the taxonomy were developed. The items from each test were equally drawn from the six cognitive classes of the taxonomy. In order to equalize the subjects' content knowledge (see General Research Problems), a reading comprehension format was used. Furthermore, "passages were carefully chosen to provide unfamiliar content." (Stoker and Kropp, 1964). The tests were administered to approximately 600 secondary school students. The scores of the tests were processed by the following techniques: a) the ordering of sub-test mean scores, b) the Guttman technique, and c) the intercorrelation technique of factor analysis (see Interval Validation).

The results did not totally support the hierarchy, but Stoker and Kropp were generally supportive of the taxonomy. They concluded: "The data gives general support to the hierarchical structure of the taxonomy. The data suggest a possible misplacement of evaluation in hierarchical structure." This was the first indication that the upper levels did not conform to the hierarchical structures.

The Smith study was based on data generated by the Stoker and Kropp (1966) study, which involved the construction of four tests based on the taxonomy. These tests used basically the same format for equalizing content knowledge as those developed in the 1964 study. They were administered to secondary students in grades nine through twelve and, although the number of students tested varied by level, no fewer than 750 were tested per level.

Smith applied a technique known as "hierarchical syndrome analysis" to the data. This is basically an intercorrelation

technique that "proceeds through stages... to select categories having a succession of common characteristics---the higher the correlation coefficient, the more similar these characheristics are considered to be." (Seddon, 1978). It should be noted that this technique has been critized as inconclusive. Seddon, for example, makes the point that "hierarchical syndrome analysis and simplex analysis (the Guttman Technique) can in fact lead to different conclusions when applied to the same correlation matrix."

For this reason, Smith's conclusion should be accepted with reservation. He states: "In general, the analysis supports the taxonomy's rationale of a cumulative and hierarchical continuum of cognitive processes." Ironically, despite the criticism of the statistical technique, Smith also concludes that the classes of Knowledge and Evaluation generally "behave in a manner inconsistent with the theoretical formulation." Smith, like Stoker and Kropp before him, questioned the placement of Evaluation in the taxonomy.

The Poole (1971) study dealt both with the taxonomy as a classification system and as a hierarchy. In fact, it was the classification system that received the greatest attention. Furthermore, the part of the study dealing with the hierarchy has come under criticism. This was due to Poole's attempt to distinguish between the complexity and difficulty of an item by "measuring item complexity as the mean of the normal fitted to the item-score-test-score regression data." (Seddon, 1978). This is regarded as an inappropriate application of this technique. Thus, it is not surprising to note that Poole found "a hierarchy with a form opposite to that proposed by the Taxonomy."

The final study to be considered is the Madaus, Woods and Nuttal (1973). This study, like Smith (1968), also used data generated by the Stoker and Kropp studies. The statistical procedure utilized by Madaus et al., however, was unique, in that a causal model approach was used. In this technique, the validity of the hierarchy is assessed by a stepwise multiple regression analysis that measures "the strengths of the linear relationships between levels." (Madaus, et. al., 1973). Furthermore, this study introduced the variable of "general ability" or g-factor into the research picture for the first time. Succeeding studies like Stedman (1973) and Roberts (1976) would also consider this g-factor.

The procedure, which has generally been accepted, suggested that the taxonomy had a Y-shaped structure illustrated in Figure 1. Furthermore, it also tentatively suggests that only the classes of Knowledge, Comprehension, Application and Analysis measure achievement dependent upon learning, whereas Synthesis and Evaluation measure general ability (see the Cognitive Taxonomy).

EVALUATION

ANALYSIS SYNTHESIS

APPLICATION

COMPREHENSION

KNOWLEDGE

The Y-Shaped Cognitive Hierarchy
Suggested by Madaus et. al. (1973)

Figure 1

Thus, in response to the question posed earlier regarding researchers being awed by cognitive hierarchy, it appears that

such reverence may not be warranted. Every study cited has questioned to a degree the structure of the hierarchy. The two most highly regarded studies, Stoker and Kropp (1964) and Madaus et. al., (1973), both concluded that, while the classes of Knowledge, Comprehension, Application and Analysis were in the correct relative order, Synthesis and Evaluation were not.

Research on the Classification System

In order to validate the taxonomy as a classification system, it is necessary that researchers demonstrate its "communicability, usefulness and suggestiveness." (Bloom, 1956). Thus, unlike the complex research associated with the hierarchical aspect of the cognitive taxonomy, researchers can validate the classification system, simply by demonstrating that it is possible to enhance communication by utilizing it. This is best demonstrated by computing the agreement between individuals utilizing the taxonomy. Bloom himself reports that he and his collaborators conducted such studies, but he provided no experimental or statistical details. He simply stated that "we have little difficulty in determining the major class within which a behavior falls." (Bloom, 1956).

Unfortunately, this is not the case with the numerous studies that have tested inter-judge agreement as it applies to the cognitive taxonomy. The results of the most significant studies are summarized in Figure 2.

Study	Number of Judges	Number of Items	Subject Matter	Percentage of Agreement
Tyler (1966)	2	384	Geography	75
Cox (1965)	3	379	Science	85
Stoker and Kropp (1964)	4	36	Chemistry	31
	4	36	Size Relations	31
Herron (1966)	5	83	Chemistry	40
Poole (1971)	6	32	Social Studies	16
Fairbrother (1975)	22	40	Physics	0
	22	40	Physics	0

Summary of Inter-Judge Agreement in the Application of Bloom's Cognitive Taxonomy

Figure 2 (Seddon, 1978)

The studies have been ordered in Figure 2 by the number of judges employed. One can readily see that, although inter-judge agreement is impressive when two or three judges are utilized, the agreement drops steadily in proportion to the number of judges. In fact, the correlation of the number of judges to the percentage of agreement is an inverse relationship ($r = -.73$).

This certainly does not support the criterion that the classification system enhances communication. Furthermore, the Fairbrother (1975) study, which made the most dismal showing in inter-judge agreement, is probably the most representative of the classification system in actual use by educators. For, unlike the other studies that utilized trained graduate students or researchers, Fairbrother utilized teachers in the field. Thus, the studies to date show the classification system of the cognitive taxonomy to be of limited use. The situation becomes clear by making reference once again

to the analogy fo the Dewey Decimal System. If libraries disagreed on the classification of a particular book, how could one locate the book in a new library?

Research continues as to the precision of Bloom's Taxonomy; Edward J. Furst (1981) recently undertook a philosophical analysis of the taxonomy. The focus of this investigation was on neutrality, comprehensiveness, cumulative hierarchial structure and usefulness. Although these four properties are claimed by the authors of the taxonomy, Furst reports that, although the taxonomy seems to be a tool being used, it appears deficient in some way in virtually every property claimed by Bloom et. al., as central to its application to practice.

It is important to recognize that, although the research reported and reviewed in by Furst consistently identifies problems with selected claims made by Bloom, virtually every investigator seems to recommend refining aspects of the taxonomy, restating the claims supporting the use of the taxonomy, or regulating the application of the taxonomy. It appears that there is support for the work of Bloom. The task they undertook was complicated and difficult and the product resulting from their work must be accepted as one of the major contributions to education in general, and program and curriculum development, educational/research and evaluation in particular.

Problems Growing From the Taxonomy

Although scholars and practioners of education alike spoke to the question of educational objectives long before the presentation of "Tyler's Rationale," this construct provided an operational link between the foundations of education (educational psychology and

educational philosophy) and the emerging field of instructional systems. The need for "scientific measures" and systematic design efforts" was expressed by those who sought to break away from the dominent themes such as "child-centeredness." The appearance of Bloom's Taxonomy provided an opportunity to implement Tyler's Rationale. This "blend of principles" moved education into a "scientific" period reminescent of the days Raymond Callahan recounts in Education and the Cult of Efficiency. (1972)

Education, especially curriculum and instructional practice, may have suffered from lack of precision prior to the adaption of the principles of "scientific management" in the early 1900's. However, once education and business jcined forces (in a collaborative effort to decrease the cost of schooling while increasing the efficiency of instruction), the goals and objectives of educational programs became practical in orientation. Maintenance of the system (a system designed to serve society) became more important than the student. (Callahan, 1972). This commitment was so strong that we can accurately refer to this position as an orthodoxy.

The opposition did not rise up for many years. The progressive sought and eventually rose as formidable adversaries to this movement. The strong position of advocacy for children and youth underminded the "efficiency movement." This movement produced zealots who embraced an ideology with a commitment equal to that of their orthodox antagonists.[3] By the 1940's, "scientific management" had lost its appeal. The Progressives had passed on sometime

[3]See Rubin, Louis J. "Synergetics and the School" for a description of the problems existing between orthodoxy & ideology.

in the late 1940's or early 1950's and cybernetics was upon us as we moved into the 1960's.

It appears that systematic instruction (in a cybernetic mode) represented a rallying point around which educators could gather. Implementation of the "Tyler Rationale" made good professional sense; the utilization of Bloom's Taxonomy provided a proclaimed neutral vehicle for addressing problems in curriculum and instruction.

Of course the current state of affairs indicates that the split within the profession continues at all levels. Orthodoxy versus idiology describes the climate of debate. The enterprise of educational practice has become "objectivefied." The Taxonomy of Educational Objectives Handbook 1: The Cognitive Domain plays a central role in directing contemporary educational practice.

The Taxonomy as Rhetoric

In the world of educational practice, the taxonomy is often presented as gospel. Although few writers claim that it is a law of learning, teacher training often presents the taxonomy as central to proper planning.

For instance, Sadker and Sadker explain that "Bloom's Taxonomy is probably the best known system for classifying educational objectives as well as classroom questions." (Cooper et. al., 1977). No special claims are made, but the teacher-to-be is then directed through 32 pages of exercises based upon the taxonomy and its six levels.

Additionally, Popham advises students "...because you surely want to be a super informed educator, here are the cognitive domain's six levels..." After elaborating on the subject, Popham suggest that, during the late 1950's, "...educators nationwide stated sporting

phrases such as 'affective objectives and cognitive objectives' with ease." (1981)

Looking back, one might ask why the taxonomy was reduced to rhetoric. Perhaps, given the crisis of the time, it felt good to grab hold of a "scientific" guide to developmental practice. Perhaps educators were not in awe of the taxonomy. Perhaps educators were desperate.

Today, in the aftermath of its popularity, the taxonomy is generally cited to legitimate our practice and ourselves.

The Taxonomy as Legitmatizing Professional Action

In this "age of accountability", assessment of the student's acquisition of course goals and objectives has become critical to planning and evaluation. The "systematic" approach to instructional planning requires that objectives be stated in observable terms. The taxonomy provides "verb vehicles" or observable behaviors which legitimatize planning efforts and are the legitimated through assessment.

Peter Oliva (1982) provides example test items designed to guide the teacher in preparing tests which cover the six levels of learning represented by the taxonomy. Prior to presenting this listing, Oliva has impressed his readers with the "fact" that the taxonomy is widely followed by those who develop objectives. Subtly this author has made the case. Theory is legitimated by practice and practice is legitimated by theory. To put another way, it would appear that, if objectives are to be used, so must the taxonomy be used. In fairness to Professor Oliva, it should be pointed out that he does make this point. He reports on practice.

Contrary to the evidence presented earlier the taxonomy is made legitimate by legitimate practice.

Argyris and Schon explain, "Every theory-in-use is a self-fulfilling prophecy to some extent." It appears that the taxonomy has become a theory-in-use and its use has given it the aura of validity.

The hierarchy set down in the taxonomy provided Professor Robert Gagné with an opportunity to explain transfer of knowledge. He points out that, "the volume by Bloom (referring to the taxonomy) and his colleagues describes a variety of kinds of measurements that may fairly be said to assess the transfer of knowledge. (1965) The statement taken from The Conditions of Learning, first edition, lent considerable support to the taxonomy. However, in the third edition of his text, Gagné points out that "...it has apparently not been easy to show that deliberate attempts to teach cognitive strategies result in constant and substantial learning and transfer of learning..." (1977)

In the first edition, the example of the taxonomy helps make a point which subtly supports the taxonomy. In the second edition, the taxonomy is not mentioned and the measurability of learning transfer is presented with less force. However, a refinement which is made twelve years after an endorsement may not negate the mind-set established in the first place. Rather than serving as a springboard for discussions, it is more likely that practioners who stumble upon the new information will not adjust their view on the validity or utility of the taxonomy.

Extended and Indirect Impact of the Taxonomy

Perhaps the most serious problem with Bloom's Taxonomy is related to its subtle use as a rationale for actions in seemingly unrelated areas. For example, consider the impact of the taxonomy as it relates to the competency based movement and teacher assessment. Dunkin and Biddle (1974) adapted Bloom's Taxonomy. Their work is currently being applied in the creation of Florida's Beginning Teacher Program. The extension of the taxonomy has taken this intellectual paradigm out of the realm of theory and, in its third generation, it is clearly institutionalized. As a theory-in-use, it is likely that the taxonomy will not be identifiable at all by the fourth generation (the implementation phase of Florida's Beginning Teacher Program).

Further, it must be recognized that Florida's Program will, upon implementation, require that those aspiring to teach, demonstrate a commitment to the "basic tenents" which appear to be grounded in "science" rather than orthodoxy. If the taxonomy becomes equal to a catechism for instruction, professionals will most likely accept it at the lower cognitive levels (knowledge, comprehension and application), rather than at the higher levels (analysis, synthesis and evaluation). This is likely, as organizational systems tend, over time, to influence the thinking of individuals by providing comfortable, acceptable models for professional performance. Once a practice is institutionalized, the most sophisticated change agents will encounter significant resistance to change efforts (Argyris and Schon, 1980, Bennis, et. al., 1976). Recognizing the power now present in the taxonomy, it should be apparent that we are vulnerable to the extended and indirect impact of efforts

growing from inappropriate use of a questionable construct.

A Reconsideration of the Taxonomy

We began this paper by pointing out that the Taxonomy of Educational Objectives Handbook 1: Cognitive Domain was selected as an example of how we in education may not always be on firm ground when our decisions are guided by reliance on an accepted paradigm and our methods are accepted because they are "scientific" in nature, but not necessarily "scientific" in fact. At this point, we feel we have demonstrated that an empirical basis for the taxonomy cannot stand as evidence of its validity. Claims on neutrality cannot result in the acceptance of the taxonomy as the foundation of objectives measures. The six levels of the taxonomy cannot be accepted as completely delimiting the scope of man's ability to learn, nor can the sequential order proposed by Bloomenthal be shown to be an accurate description of how we acquire knowledge.

However, we can (and most definitely do) respect the taxonomy. We strongly recommend that professionals in education accept this construct for what is is and use it appropriately.

Our analysis and our biases lead to the recognition that the taxonomy has fulfilled its role in attempting to synthesize emperical data and by stimulating research (Mouly, 1978). Researchers would do well to continue their efforts towards improvement of the work begun by Bloom.

Practitioners face a different challenge, the application of the taxonomy should not be reviewed as validating a particular instructional design or strategy. Rather, practitioners will benefit by incorporating the challenge posed by Elliot Eisner in The Educational

Imagination (1979) and augment their prospective to include appreciation. Appreciation is used here as it would be in the humanities. Appreciation implies the ability to go beyond knowledge and engage in an analysis of the subleties considered in rendering qualitative judgments. Once these judgments are rendered, Eisner challenges educators to engage in criticism -- public (or professional) qualitative educational evaluation.

At this point, it is suggested that the taxonomy can serve three practical purposes. First, the taxonomy has provided "process" clues to effective instruction. It is suggested that students with different learning styles may acquire knowledge more quickly and with greater ease if they approach learning problems in a mode they find comfortable. The levels of the taxonomy provide guidance in developing "process" objectives which may effectively meet the learner's stylistic needs. However, in order to use this approach, the practitioners must reject the motion that the levels proposed by Bloom et. al., are not presented in an absolute and valid hierarchy.

Another use of the taxonomy can be derived from rejecting the idea that cognitive objectives are to be assessed by cognitive measures alone. If we refuse to disassociate the cognitive and affective domains proposed by Bloom we can assess our objectives more accurately. For instance, if high school students continue to smoke after having cognitively demonstrated that they understand the implications of smoking, it cannot be stated that the instructional objective has been met, unless it has been clearly stated that the desired outcome was not to influence the student to stop smoking. Whereas some might argue that the unit was successful, as the student demonstrated mastery, a critic would argue that the unit failed,

given the observable behavior of the students. The educational connoisseur would recognize that separation by domains of learning objectives is not effective as it lacks creditability in the same way the curriculum worker understands that method and content cannot be separated. (Phenix, 1958)

Finally, research and implementation problems demonstrated to be associated directly or indirectly with the taxonomy should be appreciated by professional critics. Practitioners should develop practical tests designed to determine if the taxonomy limits instructional efforts or expands them. Once the taxonomy is appreciated as a teaching tool in terms of applied usefulness, the taxonomy will prove to be a helpful system for inter-professional communication.

Conclusions

This review and analysis was focused on Bloom's Taxonomy. Our summative finding is that few educational innovations have had equal impact upon the profession. This work has influenced researchers, measurement specialists, curriculum developers and teachers. The problem with the taxonomy must be recognized as a communication problem. There seems to be a wide gap between those who expose the contruct and those who put it to use.

We believe the taxonomy to be as good or better than most similar attempts at the classification of knowledge. We believe that there needs to be more professional criticism of this and all similar constructs or themes prior to adoption. If we fail as critics, we will become the victims of our tools and lose control of our profession. (Arendt, 1970)

The fact is that new taxonomies or modifications of existing ones are infusing our profession. This analysis of Bloom's work

and its impact will hopefully raise a flag of caution. We need not give oursleves over to any construct simply because of convenience.

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